We Claim:

1. A method of generating optical pulses with at least two cascaded Mach-Zehnder type interferometers, each Mach-Zehnder type interferometer includes an optical input and a pair of interferometer arms, said method comprising:

feeding a continuous wave optical signal into the optical input of a first of the MZIs;

modulating both arms of the first Mach-Zehnder type interferometer with a substantially sinusoidal electrical modulation signal, whereby the first Mach-Zehnder type interferometer is caused to output a series of optical pulses each having controllable chirp;

feeding the optical output of the first Mach-Zehnder type interferometer into the optical input of the second MZI;

modulating both arms of the second Mach-Zehnder type interferometer with a substantially sinusoidal electrical modulation signal, whereby the second Mach-Zehnder type interferometer is caused to output a train of optical pulses having a duty cycle that is dependent on the waveform of the electrical modulation signal being applied to at least one of the Mach-Zehnder type interferometers,

wherein the frequency of the substantially sinusoidal electrical modulation signal applied to each Mach-Zehnder type interferometer is substantially the same.

2. A method according to claim 1, wherein the substantially sinusoidal electrical modulation signals applied to each Mach-Zehnder type interferometer comprise substantially the same waveform.

3. A method according to claim 1, wherein both arms of the Mach-Zehnder type interferometers are modulated in anti-phase with a substantially sinusoidal electrical modulation signal, whereby the Mach-Zehnder type

interferometers are caused to output a train of optical pulses having substantially zero frequency chirp.

4. A method according to claim 1, wherein the Mach-Zehnders type interferometers each comprise an electro-optic material through which optical beams may propagate, and said method further comprises:

electro-optically biasing the material propagating the optical beams through at least one of the Mach-Zehnder type interferometers thereby changing a characteristic of the optical beams.

5. A method as claimed in claim 4, wherein the step of electro-optically biasing comprises:

applying a bias voltage to at least one of the Mach-Zehnder type interferometers so that the optical pulses are symmetric and substantially identical and so that the extinction ratio is maximised;

monitoring the train of optical pulses output from the last of the Mach-Zehnder type interferometers; and

adjusting the level of bias voltage being applied to substantially maintain the symmetry of the optical pulses and their homogeneity and to maximize the extinction ratio.

6. A method according to claim 1, further comprising:

biasing the modulators of each of the Mach-Zehnder type interferometers to substantially peak transmission using electrical drive signals so that the optical pulses output from the cascaded Mach-Zehnder type interferometers are symmetric about the operating point and have substantially zero frequency chirp.

7. A method according to claim 1, further comprising:

biasing the modulator of the first Mach-Zehnder type interferometer to substantially zero transmission using an electrical drive signal; and

biasing the modulator of the second Mach-Zehnder type interferometer to substantially peak transmission using an electrical drive signal to suppress the optical carrier of the output optical pulses.

8. A method according to claim 1, further comprising:

biasing the modulator of the first Mach-Zehnder type interferometer to substantially zero transmission using an electrical drive signal to suppress the optical carrier of the output optical pulses.

9. A method according to claim 1, further comprising:

biasing the modulator of the first Mach-Zehnder type interferometer to substantially quadrature point using an electrical drive signal; and

biasing the modulator of the second Mach-Zehnder type interferometer to substantially peak transmission using an electrical drive signal to cause the train of optical pulses output from the cascaded Mach-Zehnder type interferometers to have a controlled amount of chirp.

10. A method according to claim 1, further comprising:

biasing the modulators of each of the Mach-Zehnder type interferometers to quadrature point using electrical drive signals.

11. A method according to claim 1, further comprising:

generating a substantially sinusoidal electrical modulation signal using a signal generator;

splitting the substantially sinusoidal electrical modulation signal into at least two substantially sinusoidal electrical modulation signals using a power splitter; and

applying the respective substantially sinusoidal electrical modulation signals to the Mach-Zehnder type interferometers.

12. A method according to claim 11, wherein the substantially sinusoidal electrical modulation signal is split according to a pre-determined fixed ratio.

13. A method according to claim 11, wherein the step of splitting comprises:

splitting the substantially sinusoidal electrical modulation signal in a variable ratio set by a split ratio controller associated with the power splitter.

14. A method according to claim 11, further comprising:

varying the ratio of splitting the substantially sinusoidal electrical modulation signals to produce substantially sinusoidal electrical modulation signals that vary one or more of: amplitude and phase of the optical beam, and optical pulses, as desired.

15. A method according to claim 11, further comprising:

adjusting the phase of the series of optical pulses traveling between the Mach-Zehnder type interferometers using a phase-controllable waveguide located between the Mach-Zehnder type interferometers so that the phase of the substantially sinusoidal electrical modulation signals applied to the Mach-Zehnder type interferometers is synchronized with the phase of the series of optical pulses input to the Mach-Zehnder type interferometers.

16. A method according to claim 11, further comprising:

adjusting the phase of the series of optical pulses traveling between the Mach-Zehnder type interferometers using an electrical modulation signal delay line located between the Mach-Zehnder type interferometers so that the phase of the substantially sinusoidal electrical modulation signals applied to the Mach-Zehnder type interferometers is synchronized with the phase of the series of optical pulses input to the Mach-Zehnder type interferometers.

17. A method of shaping an optical pulse, said method comprising:

inputting an optical beam into a first of a plurality of cascaded Mach-Zehnder type interferometers:

applying a substantially sinusoidal electrical modulation signal to the first Mach-Zehnder type interferometer to generate a series of optical pulses having controllable chirp; and

applying a substantially sinusoidal electrical modulation signal to the following cascaded Mach-Zehnder type interferometer to shape the series of optical pulses input to following Mach-Zehnder type interferometers to produce an output train of optical pulses having a duty cycle that is dependent on the waveform of the electrical modulation signal being applied to at least one of the Mach-Zehnder type interferometers.

18. A method of varying the duty cycle of an output train of optical pulses using a first Mach-Zehnder type interferometer comprising an optical output and an electrical input, and a second Mach-Zehnder type interferometer comprising an optical input and an electrical input, the first and second Mach-Zehnder type interferometers being optically connected in series, with the optical output of the first Mach-Zehnder type interferometer being connected to the optical input of the second Mach-Zehnder type interferometer, said method comprising:

applying a substantially sinusoidal electrical modulation signal to said electrical input of said first Mach-Zehnder type interferometer to generate a series of optical pulses having controllable chirp; and

applying a substantially sinusoidal electrical modulation signal to the electrical input of the second Mach-Zehnder type interferometer to shape the series of optical pulses that are input to the second Mach-Zehnder type interferometer to produce an output train of optical pulses having a duty cycle that is dependent on the waveform of the substantially sinusoidal electrical modulation signals being applied to at least one of the first and the second Mach-Zehnder type interferometer.

19. An optical pulse generator comprising:

at least two cascaded Mach-Zehnder type interferometers optically connected in series:

each Mach-Zehnder type interferometer comprising an optical input, an optical output, and an electrical input; the optical input of a successive Mach-Zehnder type interferometer being connected to the output of the immediately preceding Mach-Zehnder type interferometer in the series;

a signal generator which, in use, produces a substantially sinusoidal electrical modulation signal for application to the electrical input of each of the Mach-Zehnder type interferometers,

wherein the first Mach-Zehnder type interferometer is responsive to the substantially sinusoidal electrical modulation signal being applied to its electrical input, to generate a series of optical pulses having controllable chirp, and each successive Mach-Zehnder type interferometer is responsive to the substantially sinusoidal electrical modulation being applied to its electrical input, to shape the series of optical pulses that is input to the Mach-Zehnder type interferometer and produce an output train of optical pulses having a duty cycle that is dependent on the waveform of the electrical modulation signal being applied to at least one of the Mach-Zehnder-type interferometers.

20. An optical pulse generator according to claim 19, further comprising:

a signal splitter for splitting the substantially sinusoidal electrical modulation signal, according to a fixed split ratio, into secondary substantially sinusoidal electrical modulation signals, each to be applied to one of the Mach-Zehnder type interferometers.

21. An optical pulse generator according to claim 20, wherein the signal splitter is adapted to be controllable so that the splitting ratio of the substantially sinusoidal electrical modulation signal is variable.

22. An optical pulse generator according to claim 21, wherein the signal splitter is adapted to control the splitting ratio of the substantially sinusoidal electrical modulation signal with respect to amplitude of the substantially sinusoidal electrical modulation signal.

23. An optical pulse generator according to claim 19, further comprising:

a bias control circuit for biasing each of the Mach-Zehnder type interferometers to substantially peak transmission such that the duty cycle of the train of optical pulses output from the cascaded Mach-Zehnder type interferometers is controllable by an amount in the range 15% to 40%.

24. An optical pulse generator according to claim 19, further comprising:

a bias control circuit for biasing the first Mach-Zehnder type interferometer to substantially zero transmission and for biasing the second Mach-Zehnder type interferometer to substantially peak transmission such that the optical carrier of the optical pulses is suppressed.

25. An optical pulse generator according to claim 19, further comprising:

a bias control circuit for biasing each of the Mach-Zehnder type interferometers to quadrature point.

26. An optical pulse generator according to claim 19, further comprising:

a phase adjuster operable to adjust the phase of the series of optical pulses traveling between the Mach-Zehnder type interferometers so that the phase of the substantially sinusoidal electrical modulation signals applied to the Mach-Zehnder type interferometers is synchronized with the phase of the series of optical pulses input to the Mach-Zehnder type interferometers.

27. An optical pulse generator according to claim 26, wherein the phase adjuster is a phase-controllable waveguide.

28. An optical pulse generator according to claim 26, wherein the phase adjuster is an electrical modulation signal delay line.

29. An optical pulse generator according to claim 19, wherein at least one of the Mach-Zehnder type interferometers has an optical path length shorter

than the optical path length of the other Mach-Zehnder type interferometer or others.

30. An optical pulse generator according to claim 19, further comprising:

a bias control circuit for maintaining bias alignment of at least one of the Mach-Zehnder type interferometers, and being electrically coupled to the electrical input of at least one of the Mach-Zehnder type interferometers, and being optically coupled to the optical output of at least one of the Mach-Zehnder type interferometers, said bias control circuit responsive to the function of the output train of optical pulses to apply a biasing electrical signal to at least one of the Mach-Zehnder type interferometers.

31. An optical pulse generator according to claim 19, wherein at least one of the Mach-Zehnder type interferometers is adapted to modulate a phase of the optical pulses.

32. An optical pulse generator according to claim 19, wherein the signal generator is adapted to supply the substantially sinusoidal electrical modulation signals to the electrical input of some of the Mach-Zehnder type interferometers; and

the optical pulse generator further comprises:

further signal generators for synchronously supplying, in use, substantially sinusoidal electrical modulation signals to the electrical inputs of the remainder of the Mach-Zehnder type interferometers.

33. An optical pulse generator comprising:

a first Mach-Zehnder type interferometer comprising an optical output and an electrical input;

a second Mach-Zehnder type interferometer comprising an optical input and an electrical input, the first and second Mach-Zehnder type interferometers being optically connected in series with the optical output of

the first Mach-Zehnder type interferometer being connected to the optical input of the second Mach-Zehnder type interferometer;

one of the first and the second Mach-Zehnder type interferometers has an optical path length shorter than the optical path length of the other Mach-Zehnder type interferometer;

an electrical drive signal generator for applying substantially sinusoidal electrical modulation signals to the first and said second Mach-Zehnder type interferometer,

wherein the first Mach-Zehnder type interferometer is responsive to the substantially sinusoidal electrical modulation signals being applied to its electrical input, to generate a series of optical pulses having controllable chirp, and the second Mach-Zehnder type interferometer is responsive to the substantially sinusoidal electrical modulation signals being applied to its electrical input, to shape the series of optical pulses that is input to the second Mach-Zehnder type interferometer to produce an output train of optical pulses having a duty cycle that is dependent on the waveform of the electrical modulation signal being applied to at least one of the first and the second Mach-Zehnder type interferometer; and

a phase adjuster operable to adjust the phase of the series of optical pulses traveling between the Mach-Zehnder type interferometers so that the phase of the substantially sinusoidal electrical modulation signals applied to the Mach-Zehnder type interferometers is synchronized with the phase of the series of optical pulses input to the Mach-Zehnder type interferometers.

34. An optical telecommunications system comprising:

at least one optical pulse generator comprising: at least two cascaded Mach-Zehnder type interferometers optically connected in series: each Mach-Zehnder-type interferometer comprising an optical input, an optical output, and an electrical input; the optical input of a successive Mach-Zehnder type interferometer being connected to the output of the immediately preceding Mach-Zehnder type interferometer in the series; a signal generator which, in use, produces a substantially sinusoidal electrical modulation signal for

application to the electrical input of each of the Mach-Zehnder type interferometers, wherein the first Mach-Zehnder type interferometer is responsive to the substantially sinusoidal electrical modulation signal being applied to its electrical input, to generate a series of optical pulses having controllable chirp, and each successive Mach-Zehnder type interferometer is responsive to the substantially sinusoidal electrical modulation being applied to its electrical input, to shape the series of optical pulses that is input to the Mach-Zehnder type interferometer and produce an output train of optical pulses having a duty cycle that is dependent on the waveform of the electrical modulation signal being applied to at least one of the Mach-Zehnder type interferometers;

a data-gate for modulating the series of optical pulses being output by the pulse generator to produce an output of optical data pulses;

a receiver for receiving the optical data pulses output from the data-gate; and

a transmission channel connecting the data gate to the receiver and along which the optical data pulses propagate from the data-gate to the receiver.

35. An optical telecommunications system comprising:

at least one optical pulse generator comprising: a first Mach-Zehnder type interferometer comprising an optical output and an electrical input; a second Mach-Zehnder type interferometer comprising an optical input and an electrical input, the first and second Mach-Zehnder type interferometers being optically connected in series with the optical output of the first Mach-Zehnder type interferometer being connected to the optical input of the second Mach-Zehnder type interferometer; one of the first and the second Mach-Zehnder type interferometers has an optical path length shorter than the optical path length of the other Mach-Zehnder type interferometer; an electrical drive signal generator for applying substantially sinusoidal electrical modulation signals to the first and said second Mach-Zehnder type interferometer, wherein the first Mach-Zehnder type interferometer is

responsive to the substantially sinusoidal electrical modulation signals being applied to its electrical input, to generate a series of optical pulses having substantially zero frequency chirp, and the second Mach-Zehnder type interferometer is responsive to the substantially sinusoidal electrical modulation signals being applied to its electrical input, to shape the series of optical pulses that is input to the second Mach-Zehnder type interferometer to produce an output train of optical pulses having a duty cycle that is dependent on the waveform of the electrical modulation signal being applied to at least one of the first and the second Mach-Zehnder type interferometer; and a phase adjuster operable to adjust the phase of the series of optical pulses traveling between the Mach-Zehnder type interferometers so that the phase of the substantially sinusoidal electrical modulation signals applied to the second Mach-Zehnder type interferometer is synchronized with the phase of the series of optical pulses input to the second Mach-Zehnder type interferometer;

a data-gate for modulating the series of optical pulses being output by the pulse generator to produce an output of optical data pulses;

a receiver for receiving the optical data pulses output from the data-gate; and

a transmission channel connecting the data-gate to the receiver and along which the optical data pulses propagate from the data-gate to the receiver.

36. An integrated chip comprising:

at least two cascaded Mach-Zehnder type interferometers optically connected in series:

each Mach-Zehnder type interferometer comprising an optical input, an optical output, and an electrical input; the optical input of a successive Mach-Zehnder type interferometer being connected to the output of a previous Mach-Zehnder type interferometer;

wherein the first Mach-Zehnder type interferometer is responsive to a substantially sinusoidal electrical modulation signal being applied to its electrical input, to generate a series of optical pulses having controllable

chirp, and each successive Mach-Zehnder type interferometer is responsive to a substantially sinusoidal electrical modulation being applied to its electrical input, to shape the series of optical pulses that is input to the Mach-Zehnder type interferometer and produce an output train of optical pulses having a duty cycle that is dependent on the waveform of the electrical modulation signal being applied to at least one of the Mach-Zehnder-type interferometers.

37. An integrated chip according to claim 36, which is formed from Gallium Arsenide GaAs.